OPERATION AND SERVICE MANUAL
for the
RYAN ST-A AIRPLANE

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INTRODUCTION

You are now the owner of a Ryan, Model ST-A Airplane. For your information and guidance in obtaining the maximum performance from this equipment, we have prepared this Manual of Operation and Service. The Manual contains valuable information for the owner or operator regarding the construction and general specifications of the airplane as well as complete inspection and service instructions. Routines of inspection, lubrication, disassembly, repair, and rigging are outlined, which if folowed, will maintain the airplane in top flying condition.

We urge those who have to do with the operation and maintenance of this airplane to read and familiarize themselves with the data contained herein.

Our Service Department is ready at all times to help you with your individual problems. In case of damage or necessary repair, first consult this Manual. If you still need help or information, write or wire our Service Manager. A prompt and informative reply will be made immediately.

Notice: Due to the expense involved in preparing and reproducing this Manual, only one copy is supplied with each airplane. Additional copies are available at $5.00 per copy, postpaid.

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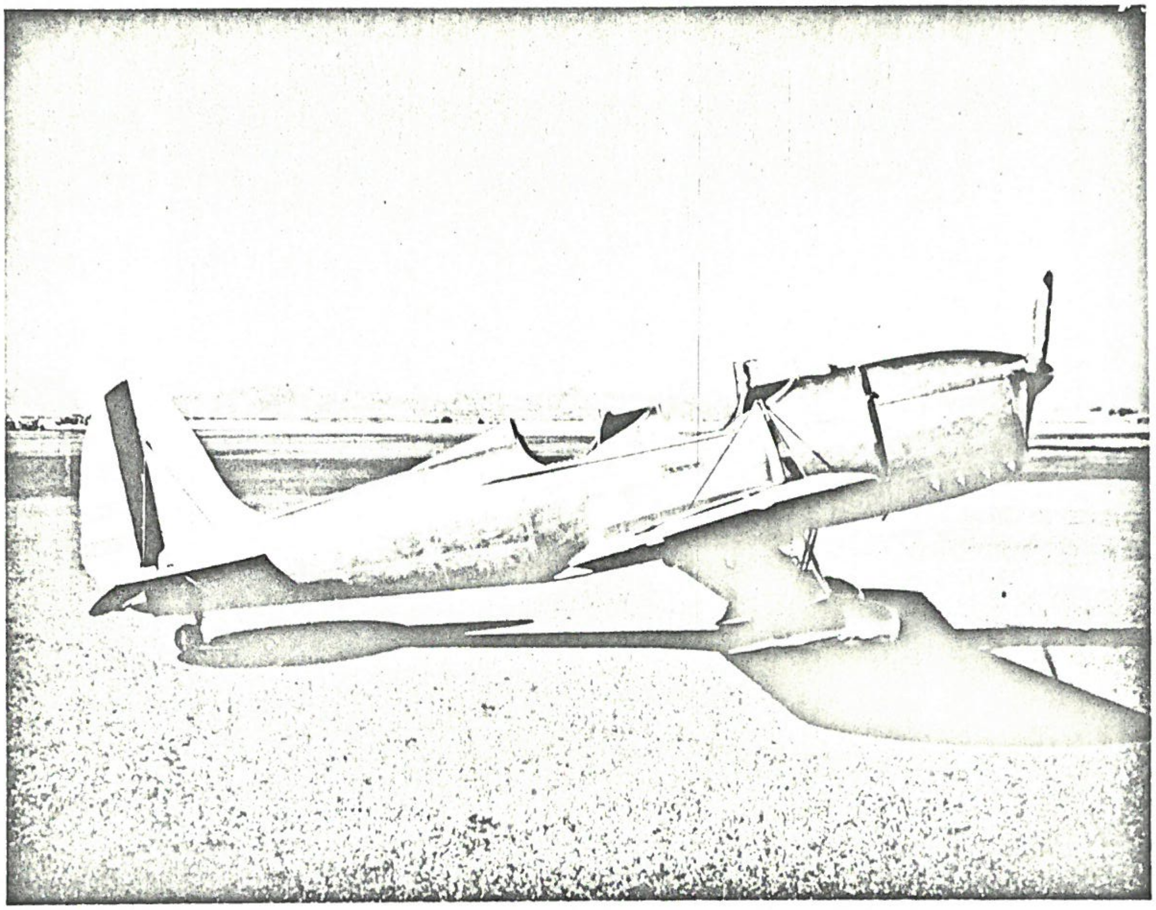


Fig. 1

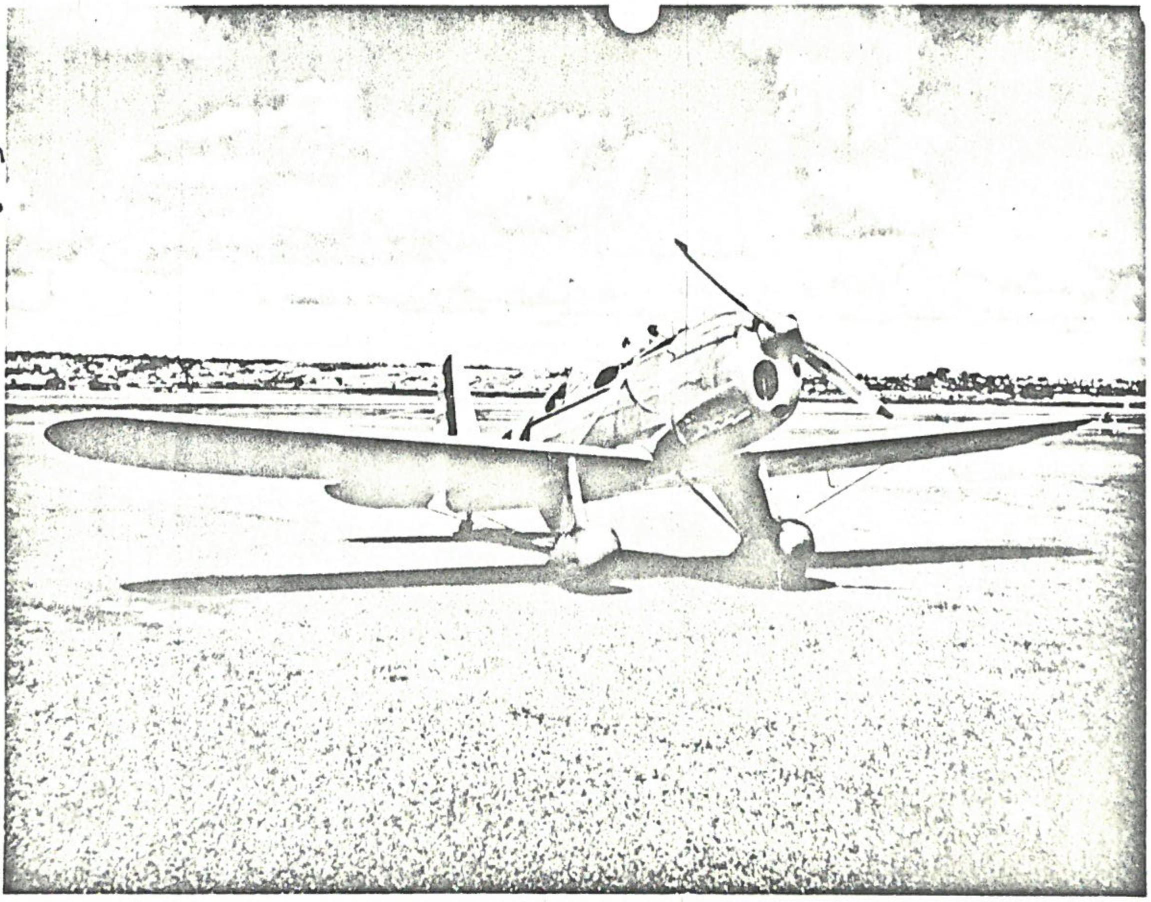


Fig. 2

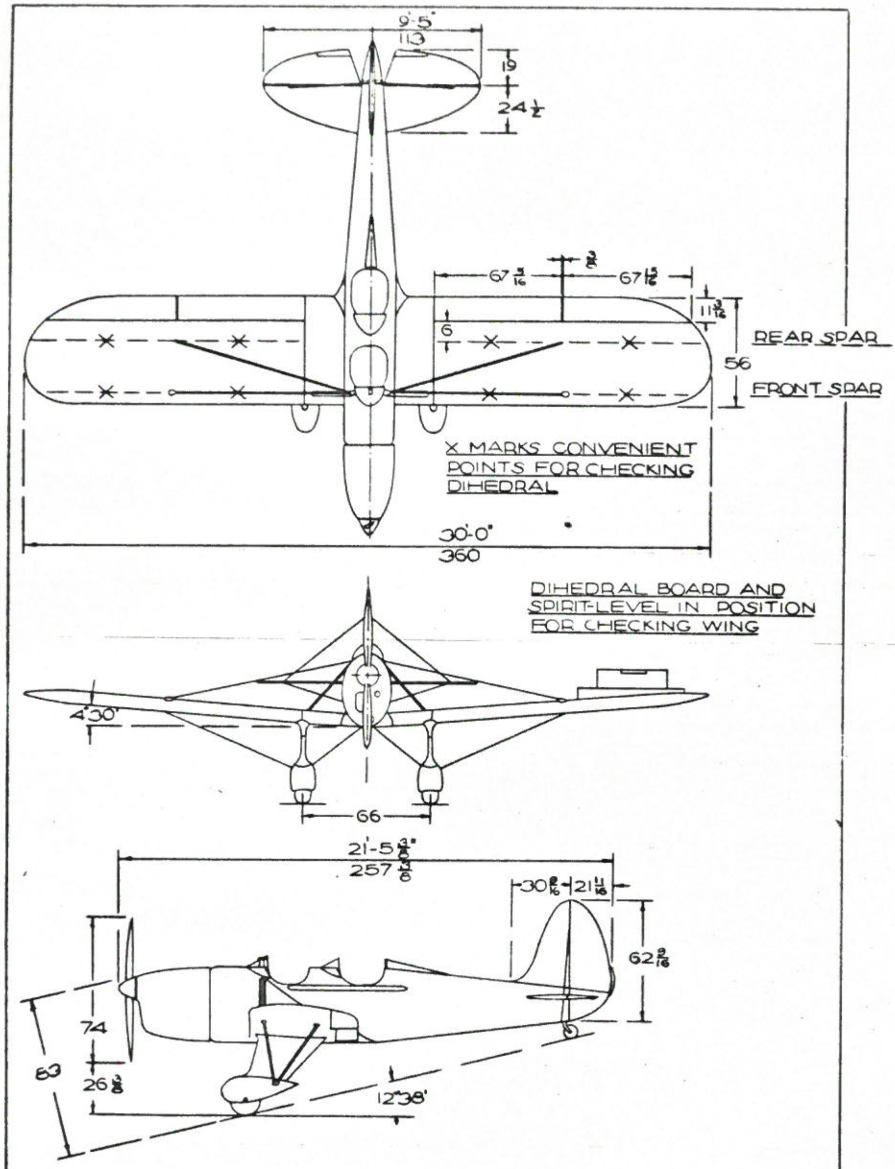


FIG. 3 -THREE VIEW

2-25-40 J.PARK

DESCRIPTION

Airplane

The Model ST-A Airplane is a two-place, low wing monoplane. See Fig. 1 and 2.

Fuselage

The fuselage is of monocoque-type construction employing longerons to reinforce the stressed skin at points of concentrated load - at stick control mountings, seats, floors, cockpit cut-outs and at the tail section. Eight elliptical transverse bulkheads, suitably spaced, are covered with heavy gauge aluminum alloy skin.

(Note: For purpose of reference in this text the bulkheads are referred to by number. Number one (#1) is the front bulkhead at the firewall. The balance are numbered in sequence ending with #8 at the tail.)

Bulkhead #2 and the lower section of bulkhead #3 are of welded chrome-molybdenum steel, S.A.E. 4130X, construction to carry the engine and wing loads.

Engine Compartment and Cowling

A stainless steel firewall isolates the engine compartment from the cockpits. The engine mount is attached to bulkhead #1 at four points and is readily removable without dismounting the engine. Cowling is N.A.C.A. type supported by two rings and four longitudinal members attached to the engine mount. The side panels are attached to the support frame with Dzus fasteners.

Wings

The wings are constructed in four fabric covered sections - two stub wings and two outer panels. The outer panels are wire braced N.A.C.A. airfoil, constructed of spruce spars, welded steel tube compression struts and aluminum alloy ribs. The stub wings are of welded steel tube construction, incorporating a walkway.

Ailerons and Flaps

The ailerons and flaps are constructed of steel tube spars and aluminum alloy ribs, fabric covered. The noses are covered with aluminum alloy sheet carried well back of the spars to form a perfect contour.

Tail Surfaces

All tail surfaces are constructed of aluminum alloy tube spars, to which are riveted the aluminum alloy ribs. All are fabric covered. The elevators incorporate metal trimming tabs for longitudinal balance.

Landing Gear and Tail Wheel

The landing gear is treadle type welded steel tube construction with shock absorber strut of oleo-spring type. Each leg consists of four component parts - (1) Vee strut assembly, (2) upper fork and shock strut assembly, (3) treadle fork assembly, and (4) wheel and brake assembly. The Vee strut. wheel fork and axle are heat treated to an ultimate tensile strength of 180,000 pounds per square inch. Wheels are equipped with Goodyear internal disc type brakes.

The tail wheel is a steerable and full swiveling unit of welded steel tube construction, equipped with oleo shock strut

Flight Controls

Surface controls are operated through cables by conventional type control sticks, rudder pedals, self-locking flap handle, tab cable drum, and toe brake pedals mounted on rudder pedal.

Engine and Propeller

ST-A airplanes are equipped with Menasco 125 h.p. type C4 engines. Propeller is Sensenich 80R-1 - wood type.

Fuel and Oil Tanks

Fuel is carried in one 24 gallon aluminum tank mounted between the firewall and front cockpit. Oil is carried in a two gallon aluminum tank mounted on the engine mount frame.

Pilot's Seats

Pilot's seats are of aluminum alloy construction with bottom well for cushion or parachute. Seats are fully adjustable by hand operated worm gear mechanism.

Safety Belts

Safety belts are provided and are attachable to brackets mounted on the floor supports.

Fire Extinguisher

A fire extinguisher is mounted between cockpits.

Utility Bag

A leather bound canvas utility bag is attached to the back of the front seat, and is accessible from either cockpit.

Bulkhead Dresser

A leather reinforced canvas dresser, attached to bulkhead #4 by "Lift the Dot" fasteners closes off the tail section of the fuselage from the rear cockpit.

Windshields

Windshields are of Plexiglass formed to contour of fuselage and mounted in a frame of aluminum alloy.

Instruments

Standard equipment for dual control consists of two each of the following instruments : altimeter, tachometer, compass, air speed indicator, oil temperature gauge, fuel pressure gauge, and oil pressure gauge.

SPECIFICATIONS

Airplane General

Overall Span	30 Ft. 0 In.
Overall Length	21 Ft. 5-3/8 In.
Overall Height, Thrust Line Level at Fin	9 Ft. 1-3/4 In.
Overall Height, At Rest (At Engine Cowl)	6 Ft. 11-1/2 In.
Height, Propeller Hub, Thrust Line Level)	5 Ft. 3-3/8 In.
Height, Propeller Hub, at Rest	6 Ft. 3 In.
Clearance, Propeller Tips, Thrust Line Level	1 Ft. 11 In.

Wing

Total Area (Including Aileron and Flaps)	124 Sq.Ft.
Chord	56 In.
Incidence	3° 0'
Dihedral	4° 30'
Sweepback	0°

Area of Other Surfaces

Aileron	5.693 Sq.Ft.
Flap	6.270 Sq.Ft.
Stabilizer	12.000 Sq.Ft.
Elevator	10.000 Sq.Ft.
Tab	0.314 Sq.Ft.
Fin	4.700 Sq.Ft.
Rudder	7.250 Sq.Ft.

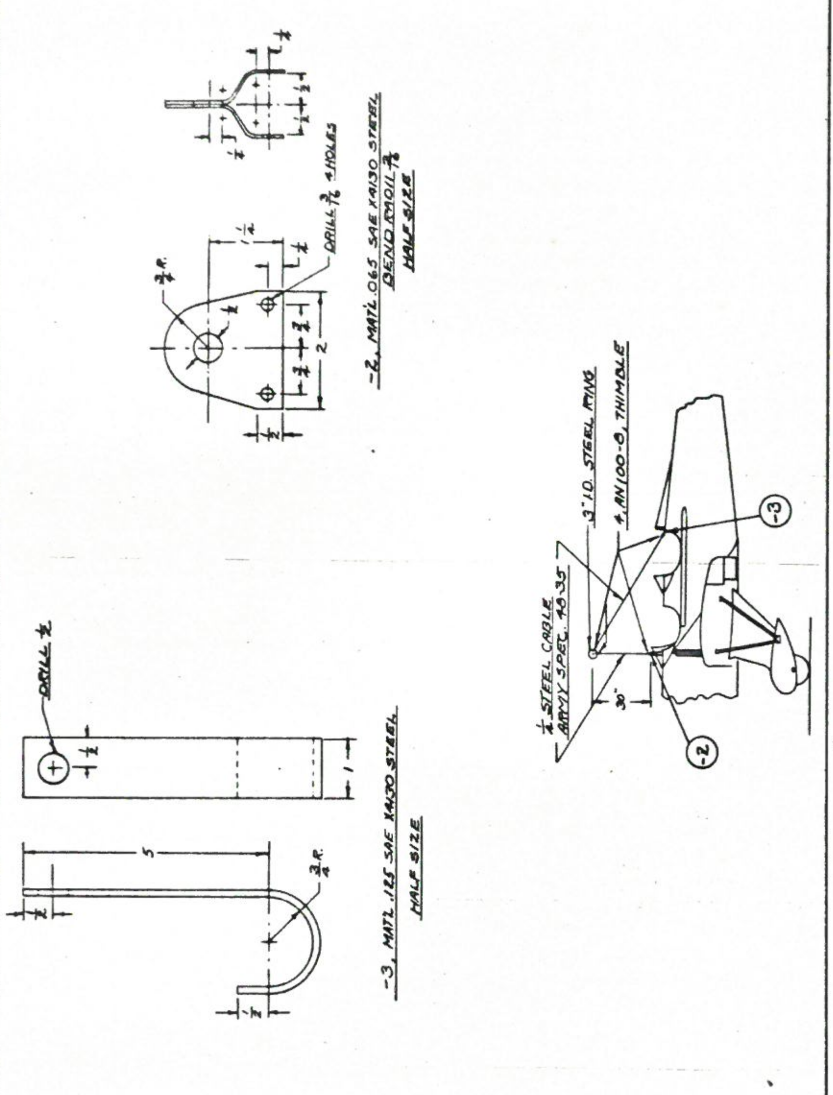
Weights

Weight Empty	1101 Lbs.
Useful Load	
Crew, two at 170	340 Lbs.
Fuel, 24 Gal.	144 Lbs.
Oil, 2 Gal.	15 Lbs.
Gross Weight	1600 Lbs.
Wing Loading	12.7 Lbs/Sq.Ft.
Power Loading	12.8 Lbs/H.P.

Engine

Bore	4.75
Stroke	4.125
Compression ratio	5.5 to 1
*Fuel Consumption	
Cruising	7-3/4 Gal.per hr.
Full Throttle (2175 R.P.M.)	10-1/2 Gal.per hr.
Fuel Capacity	24 Gal.
*Oil Consumption (Normal)	1.5 pts. per hr.
Oil Capacity	2 Gal.

Note: Fuel and Oil consumption quoted by Engine Manufacturer.



HOIST SLING

FIG. 4

4-16-40 Park

OPERATION

This section of the Manual outlines in brief form approved methods for the safe handling of the airplane on the ground and in the air. Engine and flight controls are, with minor exception, conventional in design and operation. A few departures from conventional design are incorporated in the Ryan ST-A which improve the performance of the airplane and add to the convenience of the operator. These unusual features are pointed out in this section of the Manual. Special instructions are also given with respect to certain restrictions and prohibitions which should be observed while operating the airplane.

Ground Handling

Three men are required for safe handling of the airplane on the ground; one man at each wing tip, and one at rear of airplane. Hand holds are provided at rear of each wing tip. Do not take hold of wing tip bow, ailerons, or flaps. The man at the rear of the airplane should take hold of the upper brace wire fitting attached to fin spar. If hold is taken on rudder be sure to grasp at one of the ribs. Do not raise tail wheel from ground. Jack pads are located at bottom of landing gear brace tube.

Hoisting

The turn-over post will carry the weight of this airplane empty. It is located about four inches ahead of the center of gravity. Make a special hoisting cable with fittings as shown in Fig. 4. Remove 3/16" bolts which hold turn over post cap. Bolt special hoist fitting to turn-over post. Clamp attaching fitting to #4 bulkhead. Gas and oil tanks should be drained before hoisting in order to retain the normal center of gravity.

Towing

Towing lugs are located on inner side of each landing gear strut fork just rear of wheels. For towing backwards use special dolly under tail wheel. A tail wheel saddle should be swivel-mounted on bed of this dolly. Load tail before towing.

Mooring

Mooring lugs are located on under side of front wing spars. Tie down tail wheel and set parking brakes.

Starting the Engine

Turn fuel cock shut off handle to reserve position. (Note: Engine should be allowed to run, taking fuel from reserve line until take off is made and a safe altitude reached. The shut-off valve may then be turned to use fuel from the main line. When landing turn valve to reserve position dial.)

Retard spark.

Set mixture control to full rich position.

If engine is cold, turn propeller over three to four revolutions with ignition switch "OFF".

Pump throttle two to six strokes depending on the weather conditions. If engine is warm no pumping of throttle is required.

Turn magneto switch to "BOTH ON" position.

Open throttle 1/8 or less and turn crank handle slowly simulating hand pull through of propeller. Do not spin. (Note: Failure of engine to start is frequently due to overpriming. If overpriming is suspected, turn ignition switch to "OFF " position, open throttle wide and turn engine over at least six revolutions. Then return throttle to 1/4 open position and continue normal starting procedure.

Warm up engine before take off at 600-800 r.p.m. with retarted spark. Recommended oil temperature 160° F.; maximum permissible 200° F.

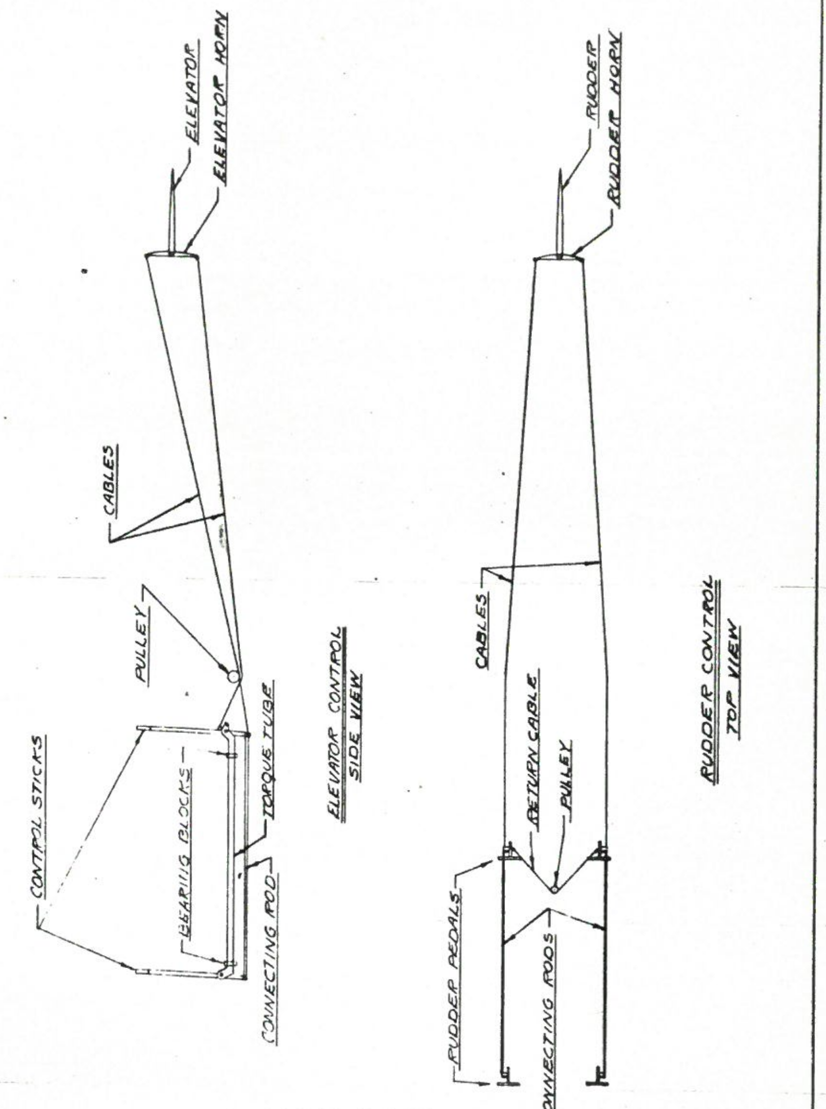
Stopping the Engine

Close throttle after engine dies cut switch.

Turn fuel shut off handle to "BOTH OFF" position.

Wobble Pump Opertion

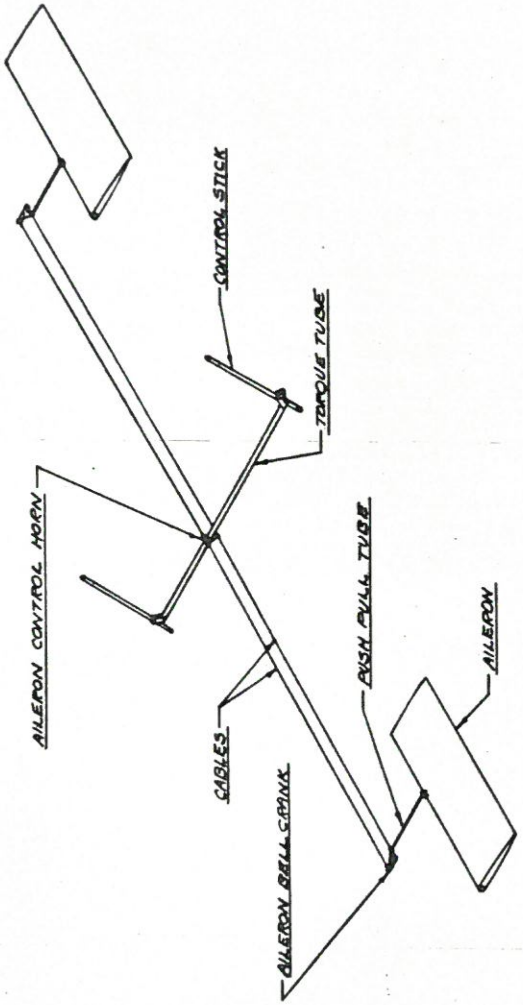
The wobble pump is located on the left lower side of the engine mount and is remote controled by a pumping lever located on the left side of pilot's seat near the floor. In the event of failure of the engine driven fuel pump, ample fuel may be pumped to the carburetor by operating this handle. Two pounds pressure should be maintained on the fuel pressure gauge.



RUDDER & ELEVATOR CONTROL SYSTEM

FIG. 5

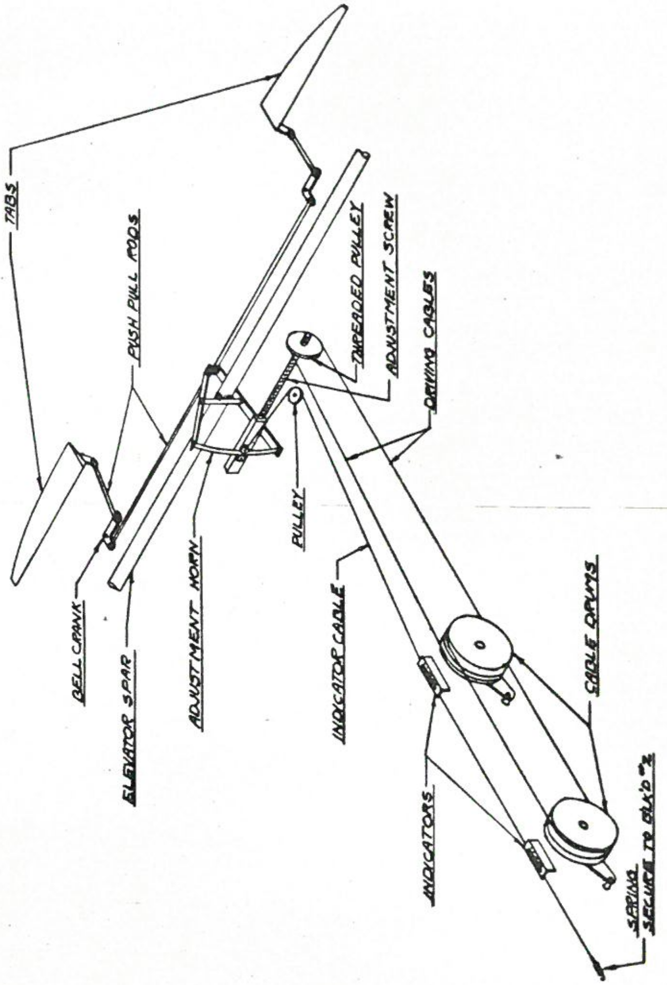
4-17-40 J.Park



AILERON CONTROL SYSTEM

FIG. 6

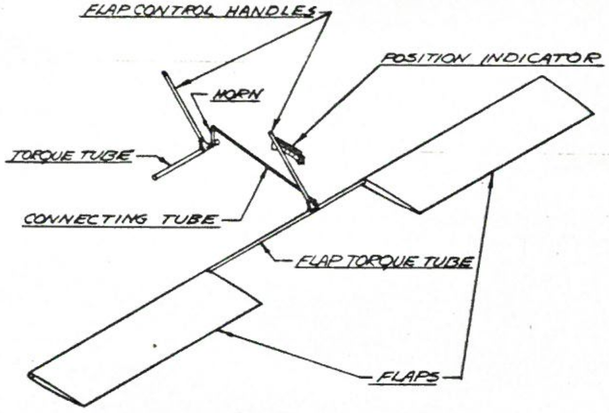
4-17-40 PARK



TAB CONTROL SYSTEM

FIG. 7

4-18-40 PARK



FLAP CONTROL SYSTEM
FIG. 8

4-17-40 PARK

Operation of Flight Controls

Controls - General - Longitudinal, lateral, and directional control in flight is accomplished in a conventional manner.

Elevators - A back pressure on the control stick increases the longitudinal angle of the airplane when in flight, while a forward pressure has the opposite effect and raises the tail, reducing the longitudinal angle.

Aileron - Aileron surfaces producing lateral control in flight are actuated by a side movement of the control stick. Movement of the stick to the left (seated in the cockpit) results in depression of the left wing. Movement in the opposite direction has the effect of depressing the right wing.

Rudder Pedals - Foot controlled rudder pedals are used in maintaining directional control both on the ground and in the air. In both cases, pressure on a rudder pedal produces a yawing turn toward the side on which pressure is applied.

Trimming Tab - Longitudinal balance of the aircraft in flight is controlled by elevator trimming tabs which are actuated by a cable wound drum, left side of cockpits. Cranking the drum forward produces a "nose down" condition. The opposite, or a "nose up" condition is created by cranking the drum backward. This control is rather sensitive, most unbalanced conditions being corrected by less than one turn of the drum.

Flaps - Flaps are actuated by the self-locking hand levers located on right side of cockpits. They are used during an approach glide to land and are left extended for duration of the landing roll. Their purpose is to create additional lift and drag, permitting an unusually high angle of descent during glides without building up excessive air speeds. Additional lift afforded by the extended flaps causes a reduction in landing speed. Flaps can be extended and retracted at will during flight without creating unusual or dangerous changes in flight characteristics. The flaps can be locked in any one of four extended positions. The degree of flap used determines the amount of drag and lift being created. A setting of from 1/2 to full extended position is advised for normal conditions. These flaps are of no especial benefit in assisting take-offs, therefore are used during approaches and landings only.

Special Instructions

Maneuvers Prohibited

Inverted flight.
Inverted spins.
Outside loops.
Snap rools at more than 105 m.p.h., indicated.
Slow rolls at more than 120 m.p.h., indicated.
Spins of more than three turns

Other Restrictions

Do not exceed indicated air speed of 198 m.p.h.
Do not exceed an engine speed of 2175 r.p.m.
Do not exceed fuel pump pressure of 3 pounds.
Do not set parking brake while airplane is in air.
Do not operate engine at full throttle on ground.

INSPECTION

We recommend that owners of Ryan ST-A airplanes adopt a routine schedule of periodic inspection, conforming to regulations of the Civil Aeronautics Authority. Common regard for safety dictates an inspection of all control systems, landing gear, instruments, brace wires, cowling and other parts open to visual inspection, immediately prior to and not more than seven days preceding flight. There should be a line inspection for each 25 hours of flying time, a more comprehensive inspection for each 50 hours of flying time, and a thorough cleaning and inspection for each 100 hours of flying time.

Civil Air Regulations require that a licensed airplane shall be given a line inspection by a licensed airman at least once within seven days preceding flight, except, however that there shall be at least one inspection for each 25 hours of flying time. After each 100 hours of flight the aircraft must be given a "periodic inspection" by a licensed mechanic. The results of these inspections shall be entered in the log by the person making the inspection.

For the convenience of Ryan owners we have prepared inspection schedules which, if followed, will assure safe flying and prevent undue wear and expense.

LINE OR 25 HOUR INSPECTION

Flight Controls

Check for freedom of operation (binding, looseness, interference)
See that cockpits are free of obstructions to controls.
Inspect rudder pedals and equalize cable for tension.
See that control sticks are secure in sockets.
Check control wires and pulleys open to inspection.
Oil hinges on control surfaces.

Engine Controls

Check rods for freedom of movement, lost motion, bent rods.
Check ignition switch connections.
Clean and lubricate ball and socket joints.
Check instruments for pointer accuracy.

Fuel System

Inspect tank and lines for leaks, cracks and breaks.
Check fuel cock for binding.
Clean strainers in tank and carburetor.
Test operation of wobble pump.

Oil System

Inspect tank and lines for leaks, cracks and breaks.
Check condition of hose connections.
Inspcet oil drain "Y" for safetying.

Brace Wires

Check condition and finish of brace wires and fittings.
Check wires for tension.

Landing and Tail Gear

Check oleo strut for leaks and loss of pressure.
Check wheels for alignment.
Check swiveling action of tail wheel.
Inspect fairings for security of attachment.
Check air pressure of tires.
Inspect brakes and brake control system - Adjust if necessary.

Engine Cowling

Check condition and security of attachment.

Seats and Safety Belts

Check attachment and fittings.
See that belt catches operate freely.
Check belts for fraying.

Windshields

Check for cracks and distortion.
Check for security of attachment.
Clean.

Propeller

Check general condition and attachment.
Check for tracking and clearance.

50 HOUR INSPECTION

Repeat 25 Hour Schedule and Inspect:

Fuel and Oil Tanks

Drain and clean strainers.
Check security of mounting and condition of straps and padding.
Check and adjust tension of straps.
Check for leaks and anchorage of lines leading from tanks.

Wings and Surfaces

Inspect covers for blisters, torn or loose fabric.
Feel for broken or loose ribs.
Check attachment fittings.

Landing and Tail Gear

Check attachment fittings for cracks and elongated holes and worn bolts.
Inspect wheels for excessive side play and worn spacers.
Remove, clean, and repack roller bearings.

Brakes

Inspect brake discs for wear.
Inspect brake cables, bellcranks, pulleys.

Fuselage

Check all accessible parts of interior and exterior for cracks, bends, or breaks in structural members, particularly at welds and sharp bends.
Check skin for scratches and dents.
Look for loose bolts, nuts, rivets, etc.

Power Plant Installation

Check engine mount and attachment fittings for cracks, breaks, and corrosion.
Check fittings for security of attachment.
Check rubber vibration absorbers for wear.
Check security of mounting of carburetor and other engine accessories.

100 HOUR INSPECTION AND CLEANING

Disassemble and Clean

Complete instructions for removing and disassembling the major assemblies of the airplane are given in the next section of this manual. Clean all parts prior to inspection. Drain holes are provided in cockpits, forward of bulkhead #2, #3, and #4. Clean cockpit and floors with good solvent. Access to rear section of fuselage is available by removing the canvas dresser attached to bulkhead #4. Doped fabric surfaces may be cleaned using luke warm or cold water and mild soap flakes. Rinse with clear fresh water and dry with chamois. Polish outer skin with good non-abrasive metal polish.

Inspection

Repeat more thoroughly and in more detail the 50 hour schedule of inspection.
Inspect all welds for cracks and breaks.

Wings and surfaces

Inspect frame structures.
Check internal brace wires of outer wing panel for tautness.
Check attachment of ribs and fittings.

Fuselage and Cowling

Repairs to metal skin, if any, should be made with materials of the same specifications and thickness as used in the original structure. Use same spacing of rivets.

Landing and Tail Gear

All cadmium plated tubes and plates should be refinished as conditions require. The Vee strut, the treadle fork, and the axle are heat treated to an ultimate tensile strength of 180,000 pounds per square inch. Cracks up to one inch (1") may be arc welded without requiring re-heat treating. Acetylene welding should be followed by heat treating. The steering horn and the fork of the tail wheel are heat treated to 150,000 pounds per square inch.

Engine and Controls

Instructions for overhaul and maintenance of engine are given in the Menasco Handbook furnished with this airplane. Check rubber mountings. Replace if worn. Clean and lubricate ball-socket joints. Check push-pull rods.

Fuel and Oil Tanks

Clean as per instructions given in the "Maintenance and Repair" section of this manual. Check tanks for leaks.

Control Cables

Check for fraying and corrosion.
To prevent corrosion apply mixture of three parts hot tallow and one part white lead.

Fire Extinguisher

Clean, check pump action and refill after each use, or once each twelve months, if not used.

Tires

Remove tires, check casings and tubes.

LUBRICATION

For your convenience, the lubrication requirements are set forth in the tabulation below. Time periods which synchronize with the inspection schedules are specified. It is recommended that lubrication be coincident with inspection, insofar as possible.

LUBRICATION TABLE

ASSEMBLY	ITEM	NO. POINTS	LUBRICANT	PERIOD (HOURS)
Landing Gear	Rear hinge bolt	2	Oil - SAE 30	20
	Wheel bearings	4	Grease - Soft	40
	Brake bellcrank	2	Oil - SAE 30	20
Tail Wheel	Mounting socket	1	Grease - Use gun	20
	Hinge bolt	1	Oil - SAE 30	20
	Wheel bearing	2	Grease - Soft	40
	Shock strut hinge	1	Oil - SAE 30	20
Elevators	Hinge bushings	4	Oil - SAE 30	20
	Control horn	1	Oil - SAE 30	20
Rudder	Hinge bushings	2	Oil - SAE 30	20
	Control horn	1	Oil - SAE 30	20
Tab Control (Tail)	Hinge bolts	4	Oil - SAE 30	20
	Quadrant rollers	1	Grease - Soft	40
	Control horn	2	Oil - SAE 30	20
Flight Controls (Cockpit)	Rudder pedal hinges	4	Oil - SAE 30	20
	Brake pedal hinges	4	Oil - SAE 30	20
	Control stick socket	6	Oil - SAE 30	20
	Torque tube bearings	4	Oil - SAE 30	20
	Tab Control drum	2	Oil - Penetrating	20
Engine Controls	Push-Pull rod clevis	6	Oil - SAE 30	20
Seat Adjustment	Worm and gear	4	Grease - Soft	40
	Seat bearing bolts	8	Oil - SAE 30	40
Aileron	Hinge bushings	6	Oil - SAE 30	20
	Bellcrank - in wing	2	Grease - Soft	40
Flap	Hinge bushings	6	Oil - SAE 30	20

DISASSEMBLY

The following procedures are intended for the guidance of operators and service crews in removing major assemblies and component parts in case of damage or for repairs or overhaul. As each part is removed, attach to it an identification tag showing name of part and location - right or left. Whenever possible, after a part is removed, reinsert bolts and fasten other attaching parts loosely at point of attachment.

To Remove Outer Wing Panel

Disconnect aileron cables at fitting on control torque tube in rear cockpit.

Disconnect electrical wiring for navigation lights. These wires can be reached through rear inspection zipper of stub wing.

Loosen landing wires two turns in order to relieve tension on flying and counter wires.

Remove front counter tie rod attached to landing gear and bottom center of fuselage. Substitute a heavy steel tube (1" diameter) or rod of equal pin center length - 34-1/4".

Remove landing gear upper strut fairing attached to landing gear brace with four machine screws and stop nuts and two P.K. metal screws.

Remove fairing strips (3 pieces) between stub wing and outer panel. The top piece is attached to front stub wing fitting with a 3/16" bolt. Elsewhere P.K. metal screws are used.

Disconnect flap spar from flap control torque tube by removing bolt located between stub wing and outer panel at rear.

Disconnect brake turnbuckle which can be reached through inspection zipper in landing gear Vee strut.

Remove bolts in connecting fittings between stub wing and outer panel.

Three men should now take up stations for removing outer panel. One at wing tip, one at root-front and one at root rear.

Disconnect flying and landing wires at either fuselage or wing connection.

The left wing carries an air speed line and pitot tube. Remove pitot tube and disconnect air speed lines.

To disconnect air speed lines, loosen the lower rear strip of wing-to-stub wing fairing. The flexible rubber tubes connecting the air speed lines may be reached at this point.

The outer panel may now be removed.

To Remove Stub Wing

Remove outer wing panel as directed in this section.

Remove landing gear as directed in this section.

Remove wing fillets between fuselage and stub wing. They are fastened by P.K. metal screws and machine screws.

Remove two bolts at fittings on stub wing spars and fittings on #2 and #3 bulkheads.

Remove three bolts at top of external streamline brace tube bolted to #2 bulkhead.

Be sure that stub wing is safely supported before removing connecting fittings bolts.

Two men are required to remove bolts and handle stub wing at final step in removal.

To Remove Aileron

Loosen nut on end of push-pull rod at aileron end.

Disconnect push-pull rod at wing end. May be reached through front zipper inspection hole of wing panel.

Remove three hinge bolts. As each bolt is removed substitute a rod or pin to hold aileron in place, until all three bolts are removed.

One man can handle removal of aileron by taking hold of trailing edge and removing pins.

Replace bolts loosely in aileron half of hinge for reassembly.

To Remove Flap

Remove fabric bolt hole patches (3) on rear edge of wing panel at hinge points.

Remove three hinge bolts. As each bolt is removed, substitute a rod or pin to hold flap in place until all bolts are removed.

One man can handle removal of flap by taking hold of trailing edge and removing pins.

Replace bolts loosely in flap half of hinge for reassembly.

To Remove Stabilizer

Remove fairing between stabilizer and fuselage.

Detach brace wires.

Loosen bolts at fuselage fitting.

Remove two bolts at connecting hinges between stabilizer and elevator.

Remove bolts attaching to connecting tubes.

Lift off stabilizer (One man can handle).

To Remove Elevator

Remove fuselage extension fairing.

Disconnect elevator from connecting tube by removing three bolts.

Remove bolt at control quadrant.

Lift off elevator (one man can handle).

To Remove Fin

Remove fairing at base of fin.
Disconnect electric wires at front fin post.
Remove landing wire.
Disconnect front fin post from fuselage channel.
Remove fin (one man can handle).

To Remove Rudder

Remove fuselage extension fairing.
Remove bolt at rudder hinge bracket.
Remove two bolts at rudder horn.
Remove two hinge bolts along rudder spar between fin and rudder.
Lift off rudder

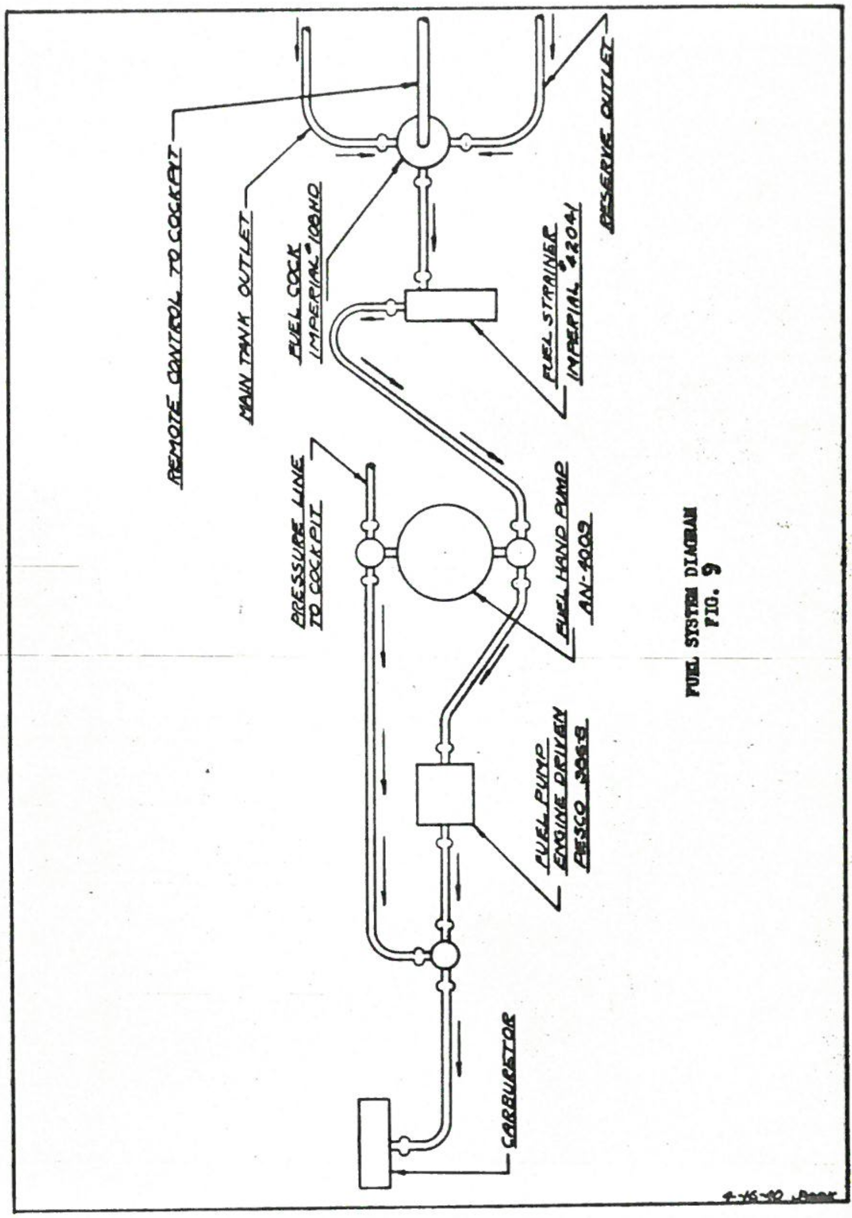
To Remove Propeller

Remove spinner, fastened to backing plate flange by 12 screws.
Remove clevis bolt in lock ring.
Unscrew lock ring using long lever bar.
The assembly may be slid forward on splined shaft.

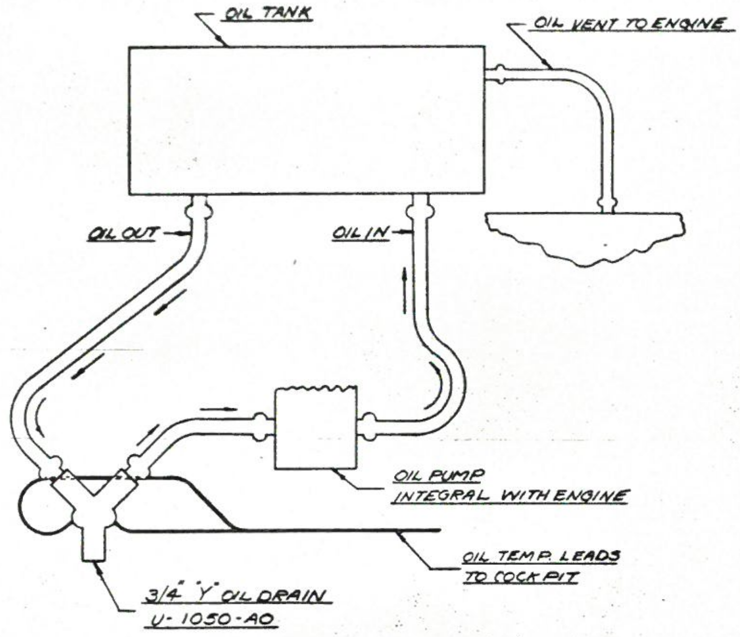
Caution: Always cover splined propeller shaft with oiled paper or cloth, when propeller is removed, to prevent rust.

To Remove Cowling

Remove propeller.
Remove four longitudinal panels, attached with Dzus fasteners.
Remove exhaust stacks.
Remove bolts (2 each) at mounting brackets (6).
Disconnect fuel drain line at manifold drain connection.
Disconnect fuel drain line at strainer shut off cock.
Disconnect drain line at fuel pump drain.
Take hold of nose cowl and slide assembly forward.


REMOTE CONTROL TO COCKPIT
MAIN TANK OUTLET
FUEL COCK IMPERIAL #108HD
FUEL STRAINER IMPERIAL #2041
RESERVE OUTLET
PRESSURE LINE TO COCKPIT
FUEL HAND PUMP AN-4009
FUEL PUMP ENGINE DRIVEN PESCO 306-B
CARBURETOR
4-16-40

FUEL SYSTEM DIAGRAM
FIG. 9



OIL SYSTEM DIAGRAM
FIG. 10

4-16-40 Park

To Remove Engine

The engine compartment forward of the firewall is an independent unit, detachable from the fuselage. To remove the engine and the engine mount as a whole:

Disconnect spark plug wires.
Turn fuel cock shut off handle to "OFF" position.
Drain carburetor and fuel lines.
Drain oil tank at oil drain "Y".
Remove propeller. (When propeller is removed oil propeller shaft splines and wrap with heavy oiled paper to prevent rust.
Remove engine cowl and panels. (Dzus fasteners)
Disconnect wobble pump actuating cables.
Remove oil and fuel drain lines. (3)
Remove exhaust stacks.
Remove engine cowl frame.
Remove fuselage nose cowl (2 pieces).
Disconnect magneto wires.
Disconnect fuel line (fuel cock to strainer)
Disconnect spark, mixture, and throttle control rods.
Disconnect tachometer drive shafts.
Disconnect oil pressure lines.
Disconnect fuel pressure lines.
Disconnect oil temperature lines at "Y" drain.
Plug "Y" drain, fuel and oil lines with rubber stoppers.

The weight of the engine assembly complete with engine, engine mount, accessories, starter, oil tank, and oil lines is approximately 370 pounds. Removal from the fuselage may be accomplished manually by three men. However, it is recommended that precautions against dropping be taken by rigging an overhead hoist with sling attached to engine mount tube just rear of rear Lord mounts and to the lifting eye or propeller shaft.

Relieve strain and drive out bottom attachment bolts.
Drive out upper attachment bolts and lift out unit.

For convenience in removing the engine from the engine mount rig up a standard for suspending the assembled unit in the same manner as suspension from the fuselage is made.

Remove oil line (oil pump to "Y" drain).
Disconnect oil line (oil tank to "Y" drain).
Remove oil line (oil tank to engine).
Remove vent line (oil tank to crank case).
Remove oil tank and oil tank mount. Entire unit may be lifted out by detaching four clamps which make attachment to engine mount members.
Remove starter shaft.

Disconnect spark control rod at left magneto.
Disconnect throttle control rod at carburetor.
Disconnect mixture control rod at carburetor.
Remove carburetor air scoop.
Disconnect fuel line bottom of wobble pump to fuel pump.
Disconnect fuel line wobble pump junction to carburetor.
(All fuel lines, oil lines, and control rods should be taped or tied up to engine mount members before attempting to remove engine.)
Remove four Lord mount bolts.
Engine may now be removed from mount either by sliding forward or lifting out vertically.

The engine weighs approximately 300 pounds and may be lifted out by three men. It is recommended that precaution be taken against dropping by rigging up an overhead hoist with sling attached at the four Lord mount brackets.

To Remove Landing Gear

Hoist front of airplane until wheels clear ground.
(Jack pads are located at the base of the Vee struts for this purpose).
Remove strut fairing and wheel pants.
Loosen landing wires two turns.
Detach flying and control wires at landing gear lug.
Remove bolts at stub wing spar attachment fittings.(2 bolts)

To disassemble the landing gear unit into its four component parts proceed as follows:

Remove through bolt which locks axle and axle retaining nut.
Unscrew and remove axle retaining nut.
Insert a piece of 1/2" pipe in axle tube and drive out axle.
This operation will free the wheel from the lower and upper forks.
Remove one 7/16" bolt at junction of oleo strut and Vee strut.
This operation will free the upper fork and shock strut assembly.
Disconnect brake cable at brake lever arm.
Loosen four adjustment set screws at junction of Vee strut and lower strut.
Remove one 3/8" x 8-1/4" bolt at junction of Vee and lower strut. This will free the lower fork from the Vee strut.

To Remove Tail Wheel

Load tail wheel.
Hoist rear of airplane until tail wheel clears ground.
Loosen rear section of fin and stabilizer fairing.
Remove fuselage extension fairing.
Detach steering springs at tail wheel steering horn.
Detach shock strut at mounting post connection. (1 bolt).
Remove bearing caps - attached to bulkhead #8. (4 bolts)
Take out Tail wheel and mounting column assembly.
Detach shock strut at fuselage. (1 bolt)
Take out shock strut assembly.

To Remove Engine Controls

Reference is made to drawing number 3-237 in order to correctly identify the various sections of the control rods discussed under this heading.

3-237-12, -13, and -14 are connecting rods between the engine control units in the cockpits. Remove clevis bolts and rod ends at front control unit and detach from rear control unit. Remove lock nuts on adjustable end and slide rods through tube support holes.

3-237-11 is the short (4-5/8") spark control rod running from rear control unit. Remove lock nuts on adjustable end and slide rods through tube support holes.

3-237-15 is the (21-1/4") rod running from the lower arm of the vertical torque tube, 3-237-53, to the engine control unit. Remove ball and socket joint and lock nut at one end and clevis bolt at cockpit end. Draw rod into cockpit through grommet in bulkhead.

3-237-53, the vertical torque tube assembly may be disassembled by taking out cotter key in top of column and loosening bolt and tubing clamp at bottom of column. Slide clamp down and pull torque tube down out of rod end.

3-237-16 is the long (43-3/8") throttle control rod running from the engine control unit to throttle bellcrank. Remove clevis at control unit. Detach ball and socket joint at bellcrank. Remove ball and socket joint, and lock nut. Draw rod into cockpit through grommet in bulkhead.

3-237-18 is the short (8-1/4") vertical throttle control rod running from the bellcrank above the carburetor to the carburetor arm. Detach ball and socket joint at both ends, and remove rod.

3-237-17 is the long (35-5/8") mixture control rod running from engine control unit to mixture bellcrank (3-237-54). Remove clevis bolt at control unit. Detach ball and socket joint at bellcrank end. Remove ball and socket joint and lock-nut. Draw rod into cockpit through grommet in bulkhead.

3-237-5 is the short (7-1/8") mixture control rod running from the bellcrank to carburetor. Detach ball and socket joint at carburetor arm. Detach ball and socket joint at bellcrank. Remove rod.

3-237-54 mixture torque tube assembly may be disassembled by removing machine screw of arm and removing arm from shaft. Loosen stop and slide off end of shaft. Bearing tube may now be removed.

To Remove Oil Tank and Mount Assembly as a Whole

Remove engine cowling top and two side panels.
Disconnect oil lines at tank and plug openings in tank and oil lines.
Disconnect four clamps on engine mount.
Lift out assembly of tank and tank mount.

To Remove Fuel Tank

Drain fuel from tank and lines.
Remove engine and engine mount.
Disconnect and remove fuel shut off cock.
Remove firewall.
Disconnect and remove fuel outlet lines from tank.
Plug all open lines.
Remove fuel level gauge.
Detach gas tank support straps.

To Remove Pilots' Seats

Remove four 3/16" bolts attaching seat to supporting frame and lift seat out of cockpit. Remove thirty 3/16" bolts attaching support frame to floor support members and lift out.

MAINTENANCE AND REPAIRS

This section of the Manual deals with routine and special maintenance and repair work which may be necessary for the upkeep of this airplane. The text has been written so as to be readily understood by the average airplane mechanic. Technical phraseology has been avoided wherever possible. We urge a careful reading of the information contained herein.

Repairs to Wings

The parts of the wing group which are subject to most wear are the aileron and flap hinges and the walkway canvas. When replacement becomes necessary it is advisable to replace bearing assembly. When the walkway shows signs of wear or tear it is sometimes possible to patch the worn spot. Generally however, the canvas strip should be replaced. It is recommended that when walkway shows signs of wear and before canvas is worn through, the worn area be resanded.

Walkway covers may be replaced or patched by observing the following procedure:

Apply one coat clear dope to both sides of canvas.
Sprinkle doped canvas and iron out wrinkles with hot iron.
Mask off balance of walkway.
Brush on one coat clear dope to walkway plate.
Apply light coat dope to under side of canvas.
Roll canvas down on walkway. Squeeze out all excess dope.
Spray two heavy coats clear dope immediately after rolling.
After last coat and while wet, sprinkle surface lightly with silica sand, #20 cut (Use flour sifter).
When dry, apply one coat clear dope.
When dry, apply two coats black dope.

Repairs to Tail Surfaces

The parts of the tail surface group which are subject to wear and most apt to require replacement are the stabilizer, elevator, and rudder hinge bushings. These bushings are press fit and may be readily replaced.

Repairs to Fuselage

The fuselage construction is such that few parts are subject to sufficient wear or exposure under normal operating conditions to require replacement. The plexiglass windshields may crack or develop a wavy condition which creates visional distortion. In such cases, the windshields should be replaced. The rear windshield assembly may be detached from the fuselage by removing fifteen screws and stop nuts. To detach the front windshield it is also necessary to detach the landing wires and remove the turn over post cap. Engine mount hangers and reinforcement fittings which attach the engine mount to bulkhead #1 are subject to heavy loads and stresses and occasionally require replacement. Rewelding of these fittings is not recommended. Gas tank straps, strap ends and hinges should be examined frequently for wear and replaced when needed. The seat adjustment mechanisms are subject to wear due to frequent adjustment. The worn worm gear and ball bearing may require replacement. Two aluminum alloy blocks are bolted to the lower side of bulkhead #8 for the tail wheel support tube hinge bolt. These blocks incorporate steel bushings which may be replaced should they become worn.

Repairs to Cowling

The panels are independent units and may be replaced individually. The mounting brackets are bolted to engine mount and cowl support rings and may be readily detached and replaced. The nose cowl is riveted to the front support ring. In case of damage the riveted assembly should be replaced.

Repairs to Landing Gear

The bearing bolt at the junction of Vee strut and lower fork is standard 3/8" x 8-1/4" nickel steel bolt - AN6-84. The bearings at this point are press fit bronze bushings made of 1/2" x .065 bronze tube 1-3/4" long and reamed to .375 + .000 -.002. The piston packing for the oleo strut consists of seven (7) rings of 1/4" graphited asbestos packing - total length about 4 feet. Brake discs may require occasional replacement. They may be secured from the Goodyear Factory at Akron, Ohio, or from the Ryan Aeronautical Company, San Diego, California.

The packing gland of the shock strut piston should be inspected occasionally for leakage and tightened to a snug fit only. Wheels and tires should be checked occasionally for alignment. An adjustment is provided at the junction of the lower fork and Vee strut. To correct misalignment, back out one set screw and tighten up on the opposite one as conditions require. Check shock strut fluid level and fill as needed with Lockheed brake fluid #5.

Repairs to Tail Wheel

The bearing block bushings are press fit and may be replaced when worn. Shock strut spring is subject to strains which may cause breakage.

Check shock strut fluid level and fill as needed with Lockheed Brake Fluid #5.
Check shock strut packing nut and tighten to snug fit.

Repairs to Engine Controls

Ball and socket joints should be replaced when adjustment fails to remove undue play or movement.

Torque and bearing tubes of bellcrank assemblies are subject to constant wear and may require occasional replacement.

Adjust, clean, and lubricate ball and socket joints as needed.

Repairs to Tanks

Before attempting any repairs to fuel tank, it is essential that all gasoline and gas fumes be removed. Steam inside of tank throughly with live steam and dry out by blowing low pressure air through the tank. Welding should be done immediately after tank has been dried, to avoid danger of explosion.

Do not apply welding heat to tank for more than a ten minute period. If welding operation requires longer time, resteam and dry the tank each ten minutes of welding.

For testing after repair apply air pressure not to exceed 2½ pounds per square inch.

> Caution: To clean tank after repairs, immerse for one hour in a 10% solution of sulphuric acid and then rinse in clean running water. Be sure that all welding flux is removed.

Cleaning Windshields

Never clean plexiglass sheet with carbon tetrachloride or thinner of any kind, nor with solvents of acetone, ethyl acetate, benzine or ethyl dichloride.

We recommend the use of Simonize cleaner for this purpose.

To bend plexiglass submerge for 15 to 30 seconds in water heated to 180° F., plus or minus 3°.

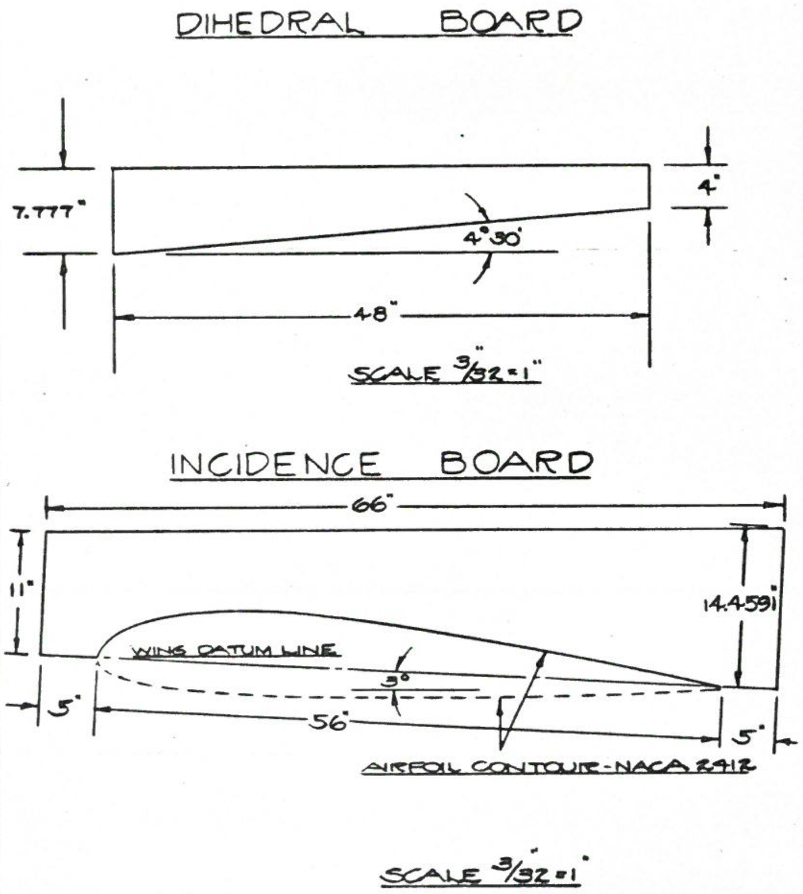


FIG. 11

RIGGING AND ADJUSTMENTS

General

The tools usually carried in the Aircraft Mechanic's tool kit are adequate for adjusting this airplane. The following supplementary equipment will facilitate the work.

One padded horse or support for tail.
Two automobile jacks - screw type.
Two "C" clamps.
One spring scale (100 pounds capacity).
One 24" spirit level.
One 48" straight edge or scale.
One protractor.
One dihedral board (See Fig. 11)
One incidence board (See Fig. 11)

Level the Fuselage

To level the fuselage longitudinally raise the tail and place a padded support under the fuselage at bulkhead #7. Place a spirit level on the outside longeron under the rear cockpit cutout. Load tail and adjust until level. To level laterally place spirit level on level lugs attached to bulkhead #3 underneath fuselage. Place an automobile jack under each landing gear jack pad and adjust until level.

Rigging the Wings

Place dihedral board, Fig. 11 on front spar line of wing, truly parallel with leading edge with wide end nearest the fuselage. Place spirit level on top of dihedral board. Adjust front flying and landing wires until level. Wing now has the correct dihedral, which is 4° 30'. If protractor is used place 48" straight edge on front spar line, set protractor for 4° 30', place on tip of straight edge and adjust until bubble shows level. The correct angle of incidence is 3° measured on chord line. To adjust wing for incidence place incidence board, Fig. 5, along third rib from tip of wing, set protractor for 3° and place on top of incidence board. Adjust rear flying and landing wires until bubble shows level.

Rigging the Ailerons

Line up the trailing edge of aileron with the trailing edge of flap. Put stick in neutral. Take up control cable until both sides have equal tension. As the throw of the ailerons is fixed, no further adjustment is necessary.

Rigging the Stabilizers

Adjust brace wires until level using spirit level along the rear spar. Coordinate adjustment of stabilizer with adjustment of fin.

Rigging the Elevators

The throw of the elevators is 22½° up and 30° down, and is fixed by stops on the control stick. Adjust control cables and check throw with protractor. The elevator tabs may be aligned by adjustment of push-pull rod terminals.

Rigging of Fin

Coordinate adjustment of fin with adjustment of stabilizer. The fin is rigged vertically and can be checked with a spirit level. Adjust landing wires for correction of rigging.

Rigging the Rudder

The maximum throw on the rudder is fixed by stops on the rudder pedals. Adjust cables so that equal throw is obtained in each direction, and tension is maintained on equalizer cable.

Brake Adjustment

Brake discs should be adjusted by means of the lock nut so that a .015" feeler gauge can be inserted between outer disc and cam. The brake lever arm should be in full "OFF" position when the brakes are fully released. When operating from muddy fields, an auxiliary spring may be installed at the brake lever to make certain that brakes release fully. If foot pedals travel becomes excessive, it is likely due to worn discs and may be corrected by removing wheel and turning up the lock nut until .015" clearance between discs is attained.

Checking the Tires

The correct inflation pressure of landing gear tires is 12½ pounds which is obtained when the rib on the shoulder of the tire is in contact with the ground with the airplane fully loaded. The correct inflation pressure of the tail wheel tire is 29 pounds.

Wheel Adjustment

An adjustment is provided at the lower end of the Vee strut for wheel alignment. Correct alignment may be obtained by backing out one set screw and tightening up on the opposite one as required. Be sure to safety set screws after adjustment.

Tail Wheel Adjustment

Adjust tail wheel axle bearing by tightening castellated nut on axle bearing bolt. The correct adjustment is accomplished when the flat bearing surfaces of the fork arm are brought up snug against spacers without binding. Do not tighten excessively as to do so will throw tail wheel out of alignment.

Tie Rod Adjustment

When adjusting tie rods it is recommended that tape be used on wrench jaws to avoid damage to the rods. The wrench should be applied at a point as close to the terminal as possible in drawing the rod tight. After tie rod is drawn to correct tension it should be locked in place with the lock nut. Be careful not to strip threads in lock nut.

To a certain extent the amount of tension to apply to tie rods is controlled by the judgment of the individual rigger. Approximately correct tension may be attained by the following procedure:

Locate and mark the center of each landing wire (measure on pin center length).
Apply a load of 50 pounds at marked center (Use an ordinary spring scale).
Measure the distance the wire deflects under this load. The minimum deflection distance of the front landing wire shall be 3/8". The maximum deflection distance, 11/16". The minimum deflection distance of the rear landing wire shall be 1/2". The maximum deflection distance 3/4".
Operating conditions and type of flying will vary the tension required. Variations should be within the range of the above limits. Keep wire vibration to a minimum.

STRUCTURAL MATERIALS

HEAT TREATMENT, WELDING AND FINISH

Aluminum Alloy

All aluminum alloy sheet used in this airplane is heat treated 24S material, except that used for fuel and oil tanks which is of 52S½H aluminum.

Rivets

Type A aluminum rivets are used in the construction of gas and oil tanks.

All other rivets used in the construction of this airplane are type D Aluminum Alloy. This type of rivet must be heat treated before using.

When repairs are made which require replacement of Type D rivets, Type AD rivets, which do not require heat treatment, may be substituted subject to the approval of your local Civil Aeronautics Authority representative. If Type AD rivets are substituted, they should be 1/32" larger in diameter than the original rivets in order to give equal strength, and fill up holes which may be drilled out oversize when removing original rivets.

If Type D rivets are used they should be heat treated in accordance with the following formula:

1. Place in oven at 940° F. for 30 minutes.
2. Quench in cold water.
3. Store in refrigerator at 0° F.

Steel

The following is a list of heat treated chrome-molybdenum, S.A.E. 4130X, steel parts:

PART NAME	PART NO.	HEAT TREAT P.S.I.
Axle - Landing Gear	5-107	160,000
Vee Strut - Landing Gear	5-108-25	180,000
Vee Strut - Landing Gear	5-108-25-1	180,000
Treadle Fork - Landing Gear	5-107-2	180,000
Treadle Fork - Landing Gear	5-107-11	180,000
Bulkhead #2	5-121	180,000
Bulkhead #3 - Lower Section	5-121A	180,000
Fork - Tail Wheel	5-113C-1	150,000
Steering Horn - Tail Wheel	5-113C-4-3	150,000
Rear Spar - Stub Wing	6-102-10	180,000
Rear Spar - Stub Wing	6-102-10-1	180,000
Control Stick	5-116-3A	180,000
Control Stick	5-116-7A	180,000
Torque Tube - Control Stick	5-116-5	180,000
Socket - Control Stick	5-116-1	180,000
Socket - Control Stick	5-116-2	180,000
Horn - Tab Adjustment	1-103-1	150,000

Heat Treating

The heat treating of metals is a highly sensitive process, requiring the supervision of a skilled technician or metallurgist. For use in extreme emergency only and when expert service is not available, the following procedure will give approximate tensile strength specified for the above chrome-molybdenum steel parts. Required temperatures may vary with type of furnace and technique employed.

Place in oven at 1200° F.
Increase gradually to 1600° F.
Hold at 1600° until metal is uniformly heated.
Remove and quench in oil at 70° F.
Replace in oven and hold for one hour at 900° F.
Remove and allow to cool in still air.

Welding

Welded steel parts which require heat treating must be welded with chrome-molybdenum welding rod.

Finishes and Protective Coatings

All aluminum alloy parts, except ribs, were anodized and given one coat of zinc chromate primer immediately after anodizing.

All steel parts were either cadmium plated or given one coat of zinc chromate primer, followed by two coats of aluminum lacquer.

Interior surfaces of aluminum alloy tubes, except fuel lines, were given one dip coat of zinc primer.

Interior surfaces of open-end steel tubes were given one coat of zinc chromate primer.

Interior surfaces of closed-end steel tubes were given one coat of hot (160° F.) raw linseed oil. Tubes were then drained and oil holes sealed with cadmium plated drive screws.

Wings and surfaces were given six coats of dope.

Control cables were dipped in mixture of three parts hot tallow and one part white lead.

MEMORANDA